Review

AQUEOUS SYSTEMS AT ELEVATED TEMPERATURES AND PRESSURES, PHYSICAL CHEMISTRY IN WATER, STEAM AND HYDROTHERMAL SOLUTIONS

Edited by Donald A. Palmer, Robert Fernndez-Prini, and Allan H. Harvey
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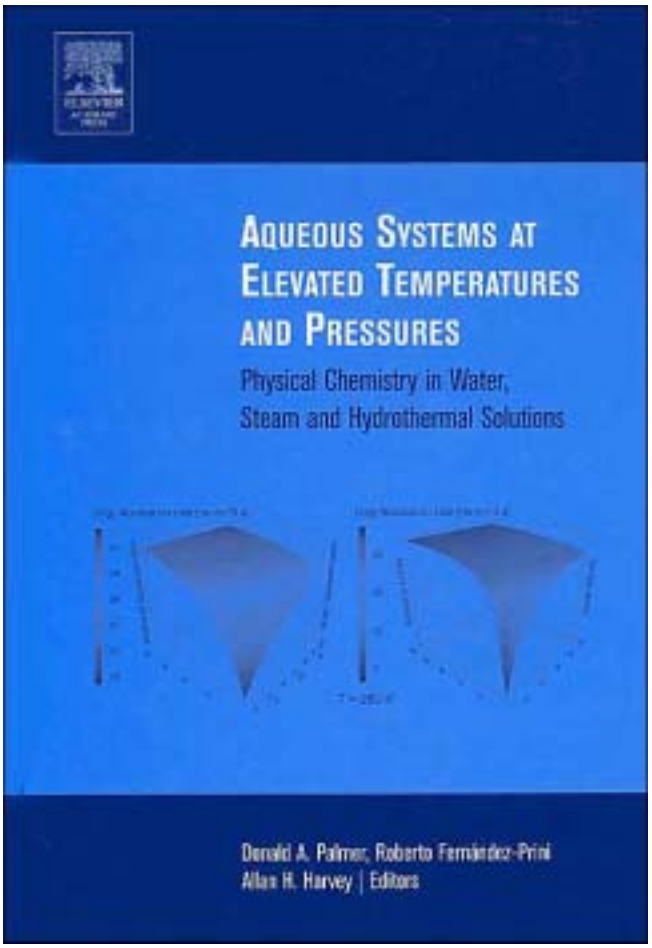
AQUEOUS SYSTEMS AT ELEVATED TEMPERATURES AND PRESSURES was produced by the International Association for the Properties of Water and Steam (IAPWS) for the purpose of providing "an accessible, up-to date overview of important aspects of the physical chemistry of aqueous systems at high temperatures and pressures." The book is primarily aimed at physical chemists, chemical engineers, and geochemists. It contains eighteen chapters plus a Foreword by Professor E.U. Franck, and has no appendices. Each chapter is a self-contained review article on a major topic, with limited cross-referencing to other chapters. Each was written by one to six experts drawn from the targeted technical disciplines. The total number of contributors is about fifty, with some authors contributing to more than one chapter. The book is aimed at the upper postgraduate and professional levels (the preface says that and I concur).



What this book mainly addresses is well summarized by its subtitle, *Physical Chemistry in Water, Steam and Hydrothermal Solutions*" Most of the chapters emphasize the measurement of thermophysical or thermodynamic properties and the theoretical interpretation thereof, much like the classic Robinson and Stokes (1965) *Electrolyte Solutions*, though the present work is more inclusive of the vapor phase. In addition to discussions of rigorous theoretical framework, there is also plenty of discussion of approximate representations exemplified by Pitzer's equations for aqueous electrolytes and the HKF equation of state for the aqueous ions. Thus, there is plenty of material here for both experimentalists and modelers. The book does not stop here. Other chapters address such topics as stable isotope partitioning, kinetics, solubility, surface adsorption, and phase equilibria. Only the final two chapters are oriented toward specific end applications, Dooley et al., *Water chemistry in commercial water-steam cycles*, and Suchanek et al., *Hydrothermal synthesis of ceramic materials*. Despite the lack of any chapters specifically devoted to geochemical applications, the book as a whole shows the influence of geochemists in this field of endeavor, and most of what is in the book is applicable in geochemistry.

The book is physically appealing with an attractive hardcover and excellent, very readable printing on high-quality paper. It weighs in at 3.4 pounds and 725 pages. It packs a lot of content. The editorial team did an outstanding job editing the contributions, or perhaps they just chose well in picking contributors. The book has a nearly seamless feel to it, despite the numerous contributors. As review articles, the chapters are uniformly very high quality, very readable, summarizing the current states of their topics and offering useful judgments. Most include a large number of references, which readers will find useful. This book is not a handbook (no steam tables, for example), but it does include a lot of useful data that is less likely to be found in an engineering handbook.

So what's not to like? My main criticism is that it is not as easy as it should be to find things in this book. The table of contents only gives the chapter titles and authors. It would have been more useful had it included sectional titles or subtitles to a first or second level. Suppose you wanted to bone up on pH at elevated temperature. Where would you go? The answer is Chapter 11, Lvov and Palmer, *Electrochemical processes in high-temperature aqueous solutions*. That isn't very obvious from the title, which in this instance probably should have been *pH in high-temperature aqueous solutions*, given the chapter's actual focus. You could readily find this material using the index, but that strikes me as a step that shouldn't be necessary. Another one: suppose you wanted to check out models for activity coefficients of aqueous ions? The answer to that one is Chapter 8, Simonson and Gruszkeiwicz, *Solute concentration effects on reaction thermodynamics in steam cycle fluids*. Here the main title is appropriate given the overall focus, but the index is less helpful in pointing to this material. This illustrates that the sectional titles should have been included in the table of contents.

Given the explosive growth of information on this topic in the past decade, the appearance of this book is very timely. However, that growth has also made it difficult to produce a single volume (even at 725 pages) that is as comprehensive as one might desire. I commend the editorial team for the nice balance that has been struck, but feel I should note for the reader's sake that in my opinion at least a few areas could have used more extensive treatment. For example, the discussion of activity coefficient models for aqueous ions in Chapter 8 seems overly limited to me, and this probably should have been the subject of its own chapter. Various models used in geochemistry and chemical engineering are discussed, but I found it glaring that some of the models now receiving a lot of attention in the chemical engineering literature (e.g., Mean Spherical Approximation and Extended UNIQUAC) are not mentioned.

Only one chapter (5, Seward and Driesner, *Hydrothermal solution structure: experiments and computer simulations*) makes a significant connection to the world of molecular dynamics and *ab initio* calculations. I would like the book to have included more on this topic. At my institution I periodically run into colleagues who do those sorts of calculations, and when I explain how I need data from new measurements (as for Pitzer interaction parameters at high temperature), they smile indulgently and say that such measurements are now obsolete and we can now calculate everything. It would appear that this is not quite so, as I cannot seem to find the relevant data, which you would think someone would have calculated by now and published somewhere. A good review of the state of the art here (what has been done, what can be done now, what problems need to be overcome) would be welcome indeed.

Despite these few points of criticism, I enthusiastically recommend adding this volume to the bookshelf or library of any geochemist interested in the physical chemistry of aqueous solutions. It is a valuable, up-to-date reference book on a breadth of topics on the physical chemistry of aqueous solutions, and most any of the review article chapters can make for a pleasant evening of technical reading.

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